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Emballonuridae Gervais, 1855 (Chiroptera) of Reserva Biológica de Saltinho (Atlantic Forest), in Brazil, revealed by echolocation

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Abstract: Seventeen species of emballonurid bats are known in Brazil, but their distribution is often determined by patchy records. However, due to almost species-specific calls, echolocation can help to refine the distribution of emballonurids. Here we use acoustic samplings to assess and complement the list of emballonurids of Reserva Biológica Saltinho, an important Atlantic Forest remnant in Pernambuco state, Northeastern Brazil. We positively matched calls of *Saccopteryx bilineata* (Temminck, 1838) that was foraging along forest edges. However, a series of calls significantly different from those emitted by *S. bilineata* indicate the presence of a second *Saccopteryx* sonotype in the area. The lower frequencies in this sonotype presumably came from a larger species, indicating the possible existence of an undescribed cryptic species of *Saccopteryx*. We also detected *Centronycteris maximiliani* (Fischer, 1829), recorded 35 years after its first record in Pernambuco, and an undetermined species of *Peropteryx* Peters, 1867. Our data proved that echolocation is a very useful technique for inventorying poorly known and hard-to-capture emballonurid species, with the potential to reveal the cryptic richness.

Key words: bioacoustics; *Centronycteris maximiliani;* cryptic species; emballonurids; Pernambuco; *Peropteryx*; *Saccopteryx bilineata*

INTRODUCTION

Found in tropical and subtropical regions, 54 species of bats belonging to the family Emballonuridae are currently known (Simmons et al. 2005; Goodman et al. 2006, 2008; Lim et al. 2010). Among those, 17 are recognized in Brazil (Nogueira et al. 2014). Like other insectivorous bats, the precise distribution of emballonurids is frequently underestimated because they often avoid mist-nets or fly far from their reach on ground level (Rydell et al. 2002; Kunz and Parsons 2009). However, due to almost species-specific calls, the use of echolocation recording techniques make detection and identification of emballonurids possible and less costly than mist-netting (Rydell et al. 2002; Jung et al. 2007). Of all Neotropical bats, echolocation is probably more studied in emballonurids (e.g., Barclay 1983; Kalko 1995; Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). Calls from this family are narrowband and multi-harmonic with an evident *quasi*-constant frequency (qCF) portion, and the frequency of maximum energy (FME) is present on the second harmonic (Jones and Teeling 2006; Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013).

As the recording of calls became more accessible (Adams et al. 2012), echolocation techniques are now being used for multiple purposes, from simply detecting the presence of bats (Estrada et al. 2004; Ford et al. 2006) to more elaborated approaches for studying bat foraging behavior (Britton and Jones 1999; Greif and Siemers 2010), niche differentiation (Sattler et al. 2007; Jacobs and Barclay 2009) or species identification (Russo and Jones 2002; Barataud et al. 2013; Horta et al. 2015). Specifically for species identification, several cryptic species of bats have been discovered based on their echolocation calls alone, or in combination with morphology and genetics (Jones and Parijs 1993; von Helversen et al. 2001; Jacobs et al. 2006; Ramasindrazana et al. 2011). For example, in Europe, Jones and Parijs (1993) linked one of the two different phonic types known for *Pipistrellus pipistrellus* (Schreber, 1774) to a potentially new cryptic species. The 45 kHz phonic type (sonotype) corresponds to *P. pipistrellus*, while the 55 kHz phonic type to *P. pygmaeus* (Leach, 1825) (Jones and Barratt 1999; Sztencel-Jablonka et al. 2009). In the western part of the Guianan Shield, an analysis of

200 acoustically identified individuals of *Pteronotus parnellii* (Gray, 1843) showed that two phonic types live in sympatry with no overlap in frequencies of their echolocation calls, with further molecular comparisons suggesting that the higher phonic type (~59 kHz) represented an undescribed species (Thoisy et al. 2014). Therefore, the recording and analysis of echolocation calls are a useful technique to study bat species identity and richness, especially for poorly known areas.

Here we use acoustic samplings to identify the emballonurids of Reserva Biológica Saltinho, an important Atlantic Forest remnant in Pernambuco state, Northeastern Brazil. We describe those sonotypes and explore the possible existence of an undescribed cryptic species for Brazil.

MATERIALS AND METHODS

Study site

This study was performed in the Reserva Biológica de Saltinho (hereafter Saltinho; 08°43′49.32″ S, 035° 10′34.95″ W, datum WGS84) (Figure 1), a 562 ha federal reserve of Atlantic Forest, near Tamandaré,

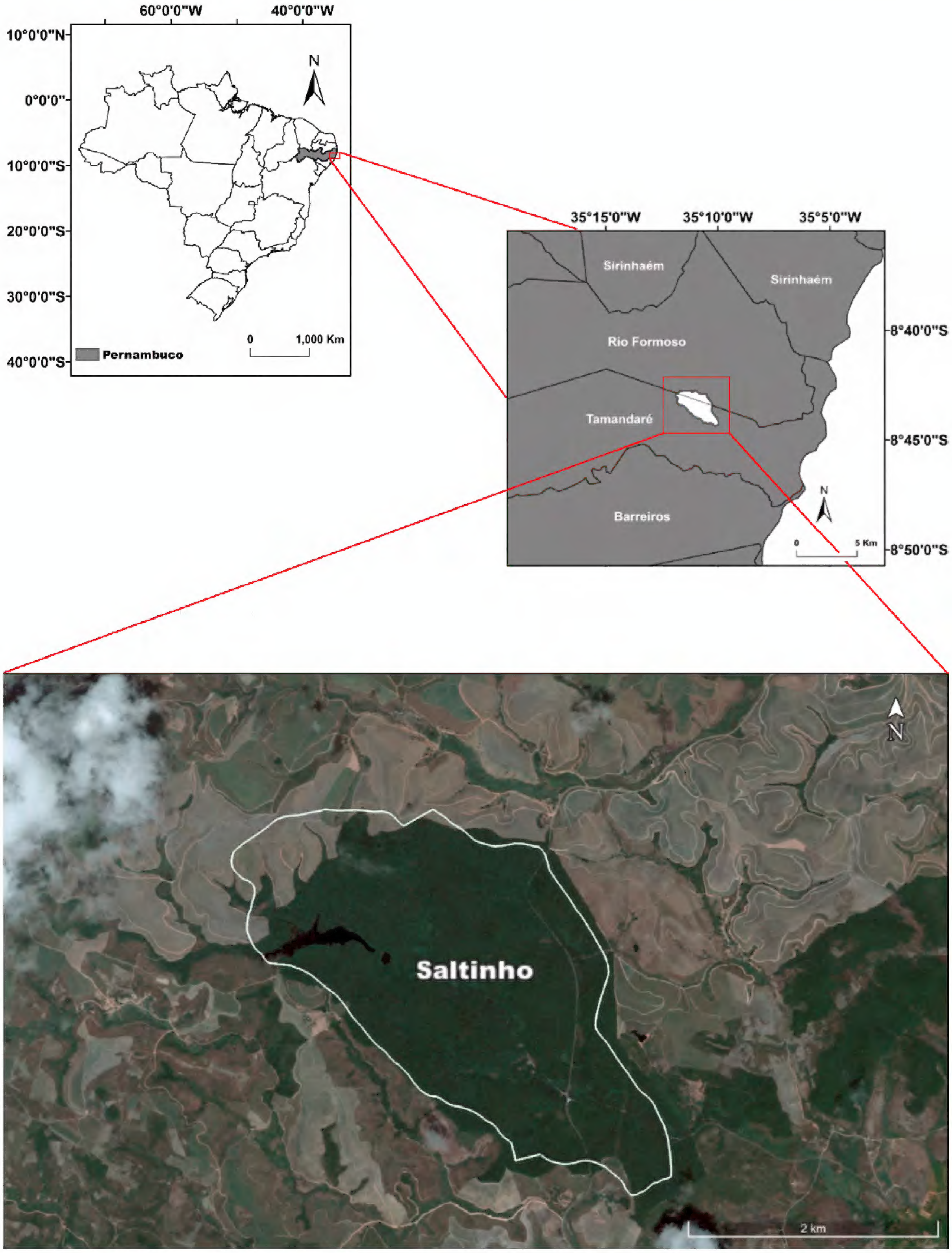

Figure 1. Location of the study area, Reserva Biológica de Saltinho, 08°43′49.32″ S, 035°10′34.95″ W (Google Earth™ Pro satellite imagery, 2016).

in Pernambuco state, Northeastern Brazil (ICMBio 2015). The climate in northeastern Brazil is constantly hot (annual temperature averaging 25°C) and humid with a dry season in the summer and a rainy season (1,500–2,000 mm) along autumn-winter (Barbosa et al. 2002; Ferraz 2002). Composed mainly of secondary forest in advanced natural regeneration, Saltinho was created in 1983, and is currently one of the largest Atlantic Forest fragments of Pernambuco (Brasil 1983; ICMBio 2015).

Data collection

Echolocation calls were recorded along four nights, between 20 November 2014 and 5 December 2014, in 15 min-transects before sunset (60 min in total), along forest edges. Bats were recorded flying alone and flying with conspecifics. Recordings were obtained with the real-time Dodotronic Ultramic™ 200K microphone (www.dodotronic.com) with 200 kHz sampling rate and frequency range up to 100 kHz, linked to an Android™ smartphone (HTC One X). Dodotronic Ultramic was configured to a medium gain amplification level. Calls were recorded using the app USB Audio Recorder Pro™ (www.extreamsd.com) and saved in .wav format.

Echolocation analysis

Echolocation analysis was performed using CallViewer18, a MATLAB based software (Skowronski and Fenton 2008). Spectrogram parameters were set to Fast Fourier Transformation size 1024, windows length equals 1 ms, and a background threshold of 10 dB, using Hanning windows. Using Auto Detection function of CallViewer18, we extracted five variables for each call detected in a file: call duration (Dur, in ms), minimum frequency (Fmin, in kHz), frequency with maximum energy (FME, in kHz), maximum frequency (Fmax, in kHz), and inter-pulse interval (IPI, in ms) of the calls. These measurements are similar to those taken by other authors as Jung et al. (2007) and Barataud et al. (2013). Auto Detection function parameters were set as minimum link length of six frames, window length 0.3 ms, 10,000 frames per second, chunk size one second, minimum energy equals 15 dB, an echo filter threshold of six dB, upper cutoff frequency of 100 kHz, lower cutoff frequency of 10 kHz, Hanning window type, and delta size equals one frame. Echolocation sequences were played using a time expansion factor of 10. Only sequences containing a minimum of five good quality calls were considered for analysis (Ratcliffe et al. 2011). Feeding buzzes (and calls after and before) or social-calls were not considered for analysis. Call structure and frequency alternation patterns are valuable for some emballonurid acoustic identifications, such as *Saccopteryx* species (Ratcliffe et al. 2011). Sonotype identification was made considering the available literature (e.g., Barclay 1983; Jung et al. 2007; Jung and Kalko 2011; Ratcliffe et al. 2011; Barataud et al. 2013). For identification proposes, we also used reference calls from the public call library (Macaulay Library, Cornell Lab 2016), as well some recordings from private call libraries (Michel Barataud, French Guiana; Maria João Pereira, Brazilian Amazon). We used for the discriminant function analysis (DFA) recordings of *Peropteryx* species from the Caatinga from our personal library. For each species, mean ± standard deviation and range were shown for all analyzed parameters.

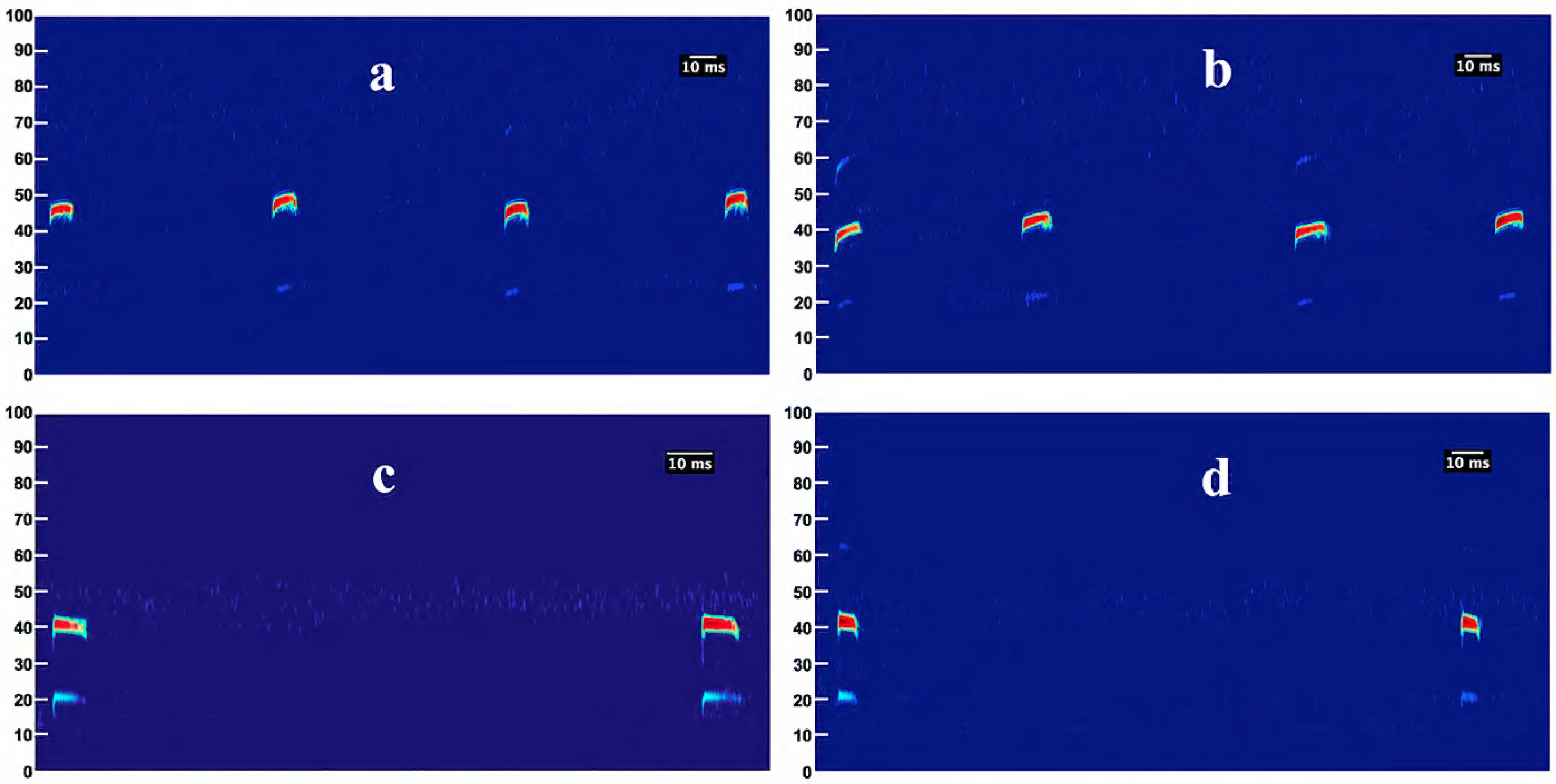

Figure 2. Spectrogram of echolocation calls recorded in the Reserva Biológica de Saltinho, Pernambuco state, Northeastern Brazil. **a:** Echolocation calls of *Saccopteryx bilineata* (sonotype S5). **b:** Echolocation calls of *Saccopteryx sp*. (sonotype S4). **c:** Echolocation calls of *Peropteryx* sp. (sonotype S7). **d:** Echolocation calls of *Centronycteris maximiliani* (sonotype S14). Call's duration and inter-pulse interval were preserved.

Using Graphpad Prism™ 6.0h (for Mac, GraphPad Software, La Jolla, California, USA, www.graphpad.com), we conducted a Kruskal-Wallis with Dunn test to access the variation of the FME between the *Saccopteryx* sonotypes on low and high calls.

Using Past 3.10 (Hammer et al. 2001), DFAs were performed in order to compare mean call parameters of each identified sonotypes with other similar sonotypes from the call libraries cited.

RESULTS

Based on echolocation calls, we found a total of four different emballonurid sonotypes. These were composed by narrowband calls with an evident qCF portion and FME permanently in the second harmonic, all characteristics typically found in calls from Emballonuridae (Figure 2).

One of these sonotypes (Sonotype S5) was positively matched to *Saccopteryx bilineata* (Temminck, 1838). A second sonotype (Sonotype S4) was identified as also belonging to *Saccopteryx* but could not be identified to species. The third sonotype (Sonotype S7) was identified as *Peropteryx* sp., and the fourth sonotype (Sonotype S14) was identified as *Centronycteris maximiliani* (Fischer, 1829).

Saccopteryx bilineata (Temminck, 1838): Figure 2a

Urocryptus bilineatus Temminck, 1838: 33 — *E[mballonura] insignis* Wagner, 1855: 695; *Saccopteryx bilineata*, Peters, 1867: 471; *Saccopteryx perspicillijer* Miller, 1899: 176.

Material examined: Table 1; Figure 2a; Figure 3.

Table 1. Echolocation call characteristics for Emballonuridae sonotypes recorded in Reserva Biológica de Saltinho, Pernambuco state, Northeastern Brazil. Mean ± Standard deviation and the minimum-maximum ranges of the parameters (in parenthesis). FME = frequency with maximum energy, Fmax = maximum frequency, Fmin = minimum frequency, Duration = call duration, IPI = inter-pulse interval, NC(NS) = number of analyzed calls (number of analyzed sequences).

Sonotype	Taxon	FME (kHz)	Fmax (kHz)	Fmin (kHz)	Duration (ms)	IPI (ms)	NC(NS)
S5	*S. bilineata* (low calls)	45.0 ± 0.7 (43.8–46.1)	46.3 ± 0.9 (45.3–47.7)	41.3 ± 1.6 (37.5–43.8)	8.3 ± 1.9 (5.7–13.1)	75.3 ± 11.1 (53.9–91.4) high–low	15(4)
	S. bilineata (high calls)	47.9 ± 0.6 (46.9–49.2)	49.3 ± 0.7 (48.4–50.0)	45.0 ± 0.7 (43.8–46.1)	8.6 ± 1.4 (7.1–12.4)	53.5 ± 12.6 (38.5–74.9) low–high	16(4)
S4	*Saccopteryx* sp. (low calls)	39.0 ± 0.9 (37.5–40.6)	40.8 ± 0.7 (39.8–42.2)	36.2 ± 2.0 (32.8–38.3)	9.3 ± 1.5 (7.6–12.0)	95.0 ± 11.0 (77.6–109.7) high–low	11(3)
	Saccopteryx sp. (high calls)	42.1 ± 0.4 (41.4–43.0)	43.8 ± 1.1 (42.2–44.5)	40.3 ± 0.6 (39.8–41.4)	9.9 ± 1.6 (7.5–12.9)	63.5 ± 10.1 (51.6–88.9) low–high	12(3)
S7	*Peropteryx* sp.	41.0± 0.3 (40.5–41.5)	41.6± 0.9 (40.5–43.5)	38.2 ± 0.8 (37.5–39.6)	9.3 ± 1.1 (7.9–10.6)	140.9 ± 29.5 (112.4–214.3)	10(1)
S14	*Centronycteris maximiliani*	41.5± 0.2 (41.4–42.2)	41.6± 0.3 (41.4–42.2)	38.1 ± 1.1 (36.5–39.6)	5.2 ± 0.4 (4.7–5.9)	154.8 ± 56.9 (108.8–250.4)	10(1)

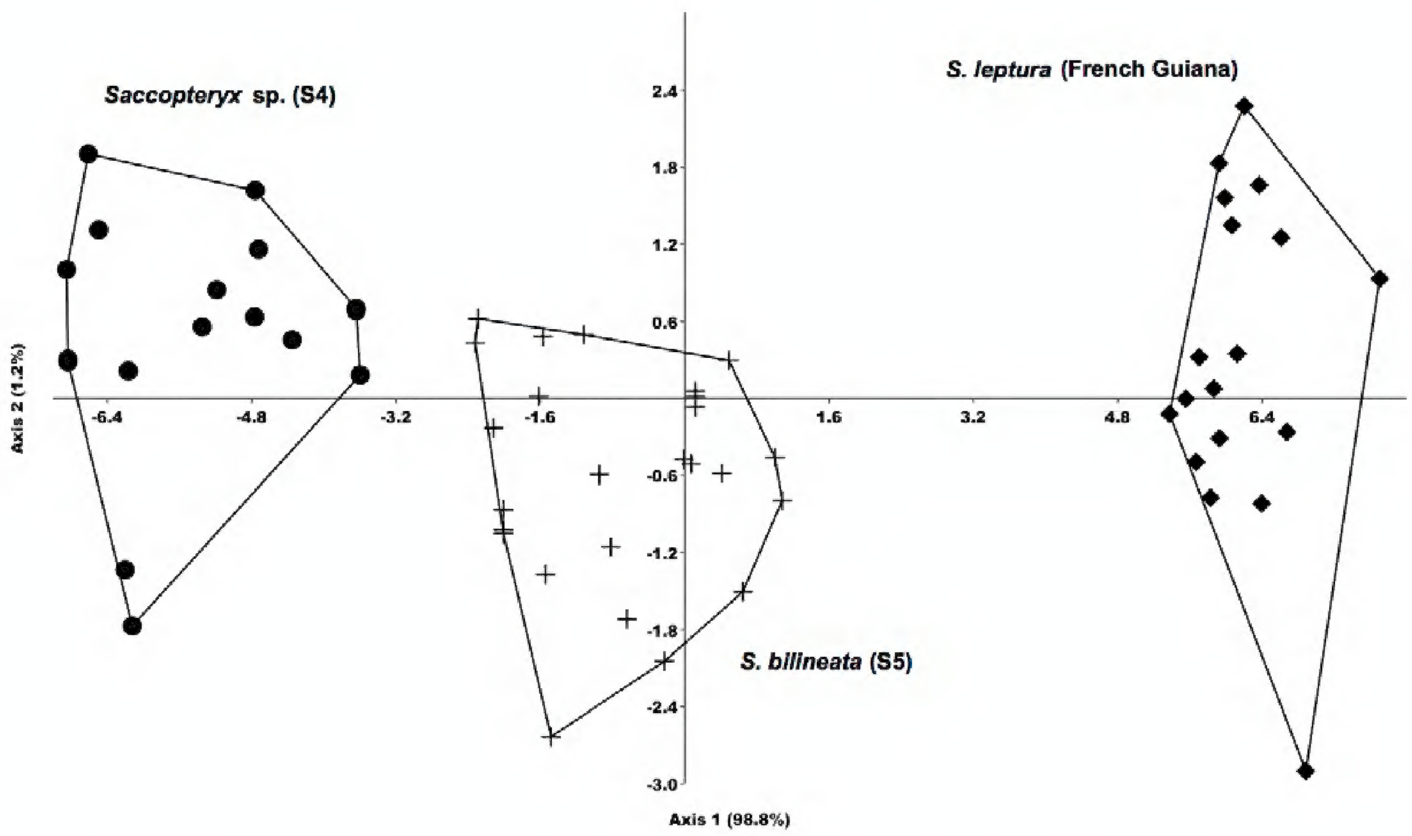

Figure 3. Discriminant function analysis (DFA) using frequencies of maximum energy, minimum frequencies, maximum frequencies and duration values extracted from echolocation calls of *Saccopteryx bilineata* (S5, +) and an unknown species of *Saccopteryx* (S4, ●), both recorded in the Reserva Biológica de Saltinho, Pernambuco State, Northeastern Brazil. For comparison proposes, we included *S. leptura* (♦) sonotype from a bat call library of French Guiana.

The sonotype S5 identified as belonging to this species was characterized by frequency alternation pattern and narrowband echolocation calls, and the qCF portion of the calls had an ascendant modulation, all unambiguous characteristics of *Saccopteryx* species (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). The sequences identified as belonging to *S. bilineata* (Figure 2a; Table 1) have alternated frequencies between ~45 kHz and ~48 kHz. The FME was present in the second harmonic of the calls as is typical for all emballonurids (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013).

***Saccopteryx* sp.**: Figure 2b

Saccopteryx Illiger, 1811: 121 — *Vespertilio* Schreber, 1774; *Urocryptus* Temminck, 1838:31

Material examined: Table 1; Figure 2b; Figure 3.

Like S5, sonotype S4 was identified as belonging to *Saccopteryx* and was characterized by frequency alternation pattern (duplets) and narrowband echolocation calls. The qCF portion of the calls had an ascendant modulation and acoustic parameters are very valuable for *Saccopteryx* species identification (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). The FME was present in the second harmonic of the calls as for all emballonurids (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). However, these sonotype sequences alternated frequencies between ~39 kHz and ~42 kHz (Figure 2b; Table 1). In fact, *Saccopteryx* is not the only genus of emballonurids that emit alternated pulses. *Cormura brevirostris* (Wagner, 1843) also uses alternating calls. However, the alternation pattern of *Cormura* clearly consists of calls emitted in triplets, with frequencies between 26, 29 and 32 kHz (Jung et al. 2007; Barataud et al. 2013). We also excluded the possibility of our recorded calls to belong to a species of the genus *Diclidurus* Wied-Neuwied, 1820. The lowest frequencies emitted by *Diclidurus* species are around 20 kHz, and the highest around 30 kHz (Jung et al. 2007; Barataud et al. 2013). The frequencies we recorded are between 26% and 36% higher than the highest frequency recorded for *Diclidurus*, which is far from the expected interspecific variation already recorded for any emballonurid. Therefore, we are confident that this sonotype belongs to an unknown cryptic *Saccopteryx* species.

***Peropteryx* sp.**: Figure 2c

Peropteryx Peters, 1867: 469–481 — *Peronymus* Peters, 1868: 145.

Material examined: Table 1; Figure 2c; Figure 4.

The sonotype S7 identified as *Peropteryx* sp. was characterized as monotonous (without frequency alternation) and narrowband calls with a final FM component and slight descending modulation of the qCF portion (Figure 2c). The FME averaged 41 kHz and was present in the second harmonic of the calls as for all emballonurids. The calls also had an average duration of 9 ms (Table 1) (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). Data available in the literature (Jung et al. 2007) indicates that calls of *P. macrotis* (Wagner, 1843) in Panamá and Costa Rica average about 39 kHz (39–41 kHz). According to Barataud et al. (2013), calls for the same species in French Guiana average 38 kHz (37–40 kHz) and those for *P. trinitatis* Miller, 1899 average 44 kHz (42–44 kHz). Our *Peropteryx* calls averaged 41 kHz (40–41 kHz), which is closer to the calls emitted by *P. macrotis*. Regional variation of calls could explain the differences we observed, but our recordings from *P. macrotis* and *P. trinitatis* in the Caatinga of Pernambuco do not match

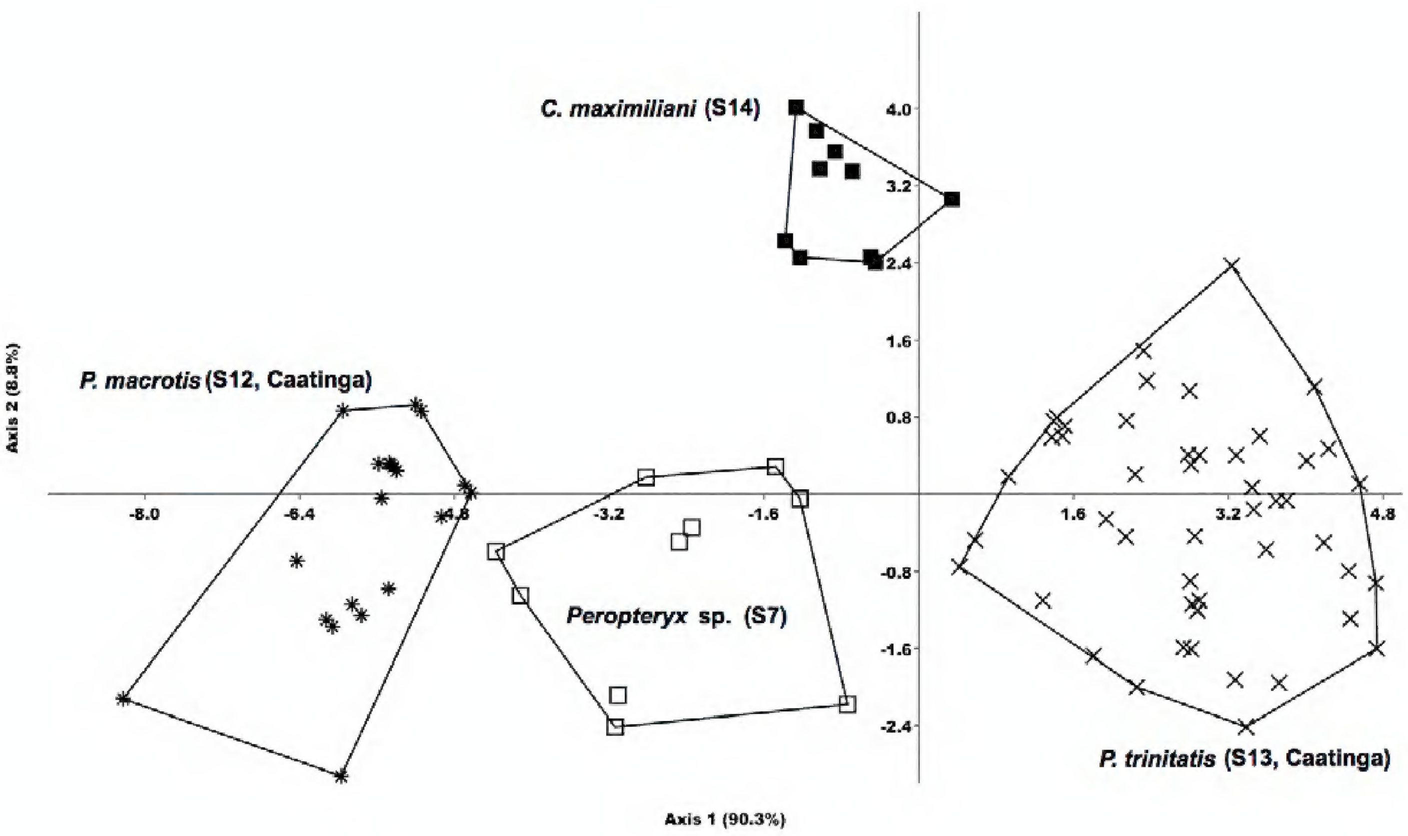

Figure 4. Discriminant function analysis (DFA) using frequencies of maximum energy, minimum frequencies, maximum frequencies and duration values extracted from echolocation calls of *Peropteryx* sp. (S7, ×) *Centronycteris maximiliani* (S14, ■), both recorded in the Reserva Biológica de Saltinho, Pernambuco State, Northeastern Brazil. For comparison proposes, we included *Peropteryx trinitatis* (S13, ×) and *P. macrotis* (S12, –) sonotypes from our bat call library of Caatinga biome.

with this *Peropteryx* sonotype (Figure 4). Considering the relation between frequency and body mass, it is plausible that this sonotype belongs to *P. pallidoptera* Lim, Engstrom, Reid, Simmons, Voss & Fleck, 2010 or *P. leucoptera* Peters, 1867, species for which their body masses are between *P. macrotis* and *P. trinitatis* (Bogdanowicz et al. 1999; Jung et al. 2007; Lim et al. 2010). However, the possibility that this sonotype belongs to *P. macrotis* cannot be disregarded; we were not confident in identifying this sonotype to species.

Centronycteris maximiliani (Fisher, 1829): Figure 2d
Vespertilio maximiliani Fischer, 1829: 112–113 — *Vespertilio calcaratus* Schinz, 1821: 180; *Vespertilio maximiliani* Fischer, 1829: 112–113; *Emballonura calcarata* Temminck, 1841: 299; *Proboscidea calcarata* Gray, 1838: 499; *Centronycteris calcarata* Gervais, 1856: 69; *Saccopteryx calcarata* Dobson, 1878: 376; *Saccopteryx wiedi* Palmer, 1898: 110; *Centronycteris wiedi* Trouessart, 1904: 98; *Centronycteris maximiliani* Miller, 1907: 91.

Material examined: Table 1; Figure 2d; Figure 4.

The sonotype S14, identified as belonging to *C. maximiliani*, was characterized by monotonous and narrowband calls with marked initial and final FM components and a straight modulation of the qCF portion (Figure 2d). The FME averaged at 41 kHz and was present in the second harmonic of the calls as for all emballonurids, and the calls also had an average duration of 5 ms (Table 1) (Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013).

Statistically significant differences were found between FME for both *Saccopteryx* sonotypes (H = 50.12, $p < 0.0001$). Dunn's comparisons confirmed significant differences between the FME of the lower (Diff = 25.0, $p < 0.05$) and higher calls (Diff = 29.0, $p < 0.0001$) for both sonotypes. As expected, no differences were found between the FME of the calls of the same taxa (*S. bilineata*: Diff = 13.5, $p = 0.055$; *Saccopteryx* sp.: Diff = 11.5, $p = 0.468$). In comparison with the *S. leptura* (Schreber, 1774) sonotype, the DFA confirmed two distinct groups based on the echolocation parameters of *S. bilineata* and the second *Saccopteryx* sonotype (Figure 3). We selected 31 calls from four sequences of *S. bilineata* and 23 calls from three sequences of the unknown recorded *Saccopteryx* sp. for a detailed analysis (Table 1).

In comparison with *Peropteryx trinitatis* and *P. macrotis* sonotypes, the DFA performed confirmed distinct groups based on the echolocation parameters of *C. maximiliani* sonotype (Sonotype S14) and the *Peropteryx* sonotype (Sonotype S7) (Figure 4). We selected 10 calls from one sequence of *Peropteryx* sp. and 10 calls from one sequence of *C. maximiliani* for a detailed analysis (Table 1).

DISCUSSION

Currently, in Pernambuco state, there are records of captured individuals of *Saccopteryx bilineata* and *S. leptura* (Guerra 2007), but so far none had their calls recorded. Relying on the patterns and characteristics of echolocation calls, we believe that we recorded the presence of a third *Saccopteryx* species in the state, a possible undescribed cryptic species for Northeastern Brazil. This sonotype presented the same echolocation patterns as *S. bilineata*, but with lower frequencies (e.g., Jung et al. 2007; Ratcliffe et al. 2011; Barataud et al. 2013). Moreover, our recordings also indicate the presence of *S. bilineata* in sympatry with the unknown sonotype, demonstrating this sonotype should not be perceived as a regional variation of *S. bilineata* calls.

Considering the negative correlation between body size and call frequency observed in bats (e.g., Bogdanowicz et al. 1999; Jung et al. 2007), it is very likely that this unknown sonotype was emitted by a species larger than *S. bilineata*. Therefore, this evidence dismisses that this new sonotype belongs to *S. leptura*, *S. gymnura* Thomas, 1901 or *S. canescens* Thomas, 1901 because these species are smaller bodied than *S. bilineata* (Yancey et al. 1998; Gardner 2008).

The possibility of new cryptic species in the genus *Saccopteryx* has been previously recognized. Studies using DNA barcoding for specimens from Central America and northern South America revealed that *S. bilineata* has three different intraspecific mtDNA lineages that strongly support the existence of cryptic species (Clare 2011; Clare at al. 2011). Considering no specimens from the Atlantic Forest were analyzed in those studies, the possibility of additional cryptic species is possible. Interestingly, the acoustic parameters exhibited by the *S. bilineata* sonotype recorded in Pernambuco were closer to Central America sonotypes than those from nearby areas, such as French Guiana or northern Brazil (Barclay 1983; Jung et al. 2007; Jung and Kalko 2011; Ratcliffe et al. 2011; Barataud et al. 2013). The reason behind such an unusual find remains unclear, but with the evidence presented here of a possible cryptic species, the morphology and genetics of specimens of *S. bilineata* in collections from Northeastern Brazil must be made. Several of recently described bat species were stored and misidentified in collections for several years (e.g., Gregorin and Ditchfield 2005; Dias et al. 2013; Moratelli and Wilson 2014), and it would not be surprising to find that this unknown *Saccopteryx* species was similarly overlooked.

The only previous record of *C. maximiliani* in Pernambuco was a female collected in Saltinho in 1978 (Guerra 2007). Therefore, the recorded sonotype of *C. maximiliani* is important, not only because it is the first acoustic record of this species for Pernambuco, but also because it confirms that this poorly known species remains present in the reserve after 37 years. Although widespread across South America, *C. maximiliani* is rarely captured with net sampling; currently there are only 14 records of captures in Brazil, but only three of

those records were not in the Amazonian biome (Rocha et al. 2015).

The identification of the recorded *Peropteryx* sonotype to species is challenging. The recorded calls are between the frequencies described for *P. macrotis* and *P. trinitatis* (Jung et al. 2007; Barataud et al. 2013), averaging 41 kHz, which is closer to the calls emitted by *P. macrotis,* However, our DFA clearly separated our calls to those belonging to other species, with no overlap with *P. macrotis* nor *P. trinitatis*. Although the possibility of *P. macrotis* cannot be disregarded, by exclusion and considering the negative correlation between body size and call frequency (e.g., Bogdanowicz et al. 1999; Jung et al. 2007) this sonotype may belong to *P. leucoptera* or *P. pallidoptera*. Actually, the only record of *P. pallidoptera* in Brazil was in Pará state (Nogueira et al. 2014). Guerra (2007) reported *P. leucoptera* for Pernambuco, in the Dois Irmãos Estadual Park and in São Lourenço da Mata and Rio Formoso municipalities, all in Atlantic Forest.

Bioacoustics devices are now affordable (Rydell et al. 2002; Adams et al. 2012) and complement netting efforts (O'Farrell and Gannon 1999; Sampaio et al. 2003; Kunz and Parsons 2009). Most emballonurids, vespertilionids, and molossids are easily detected by their echolocation calls but are difficult to sample using netting (Rydell et al. 2002). Our results emphasize the importance of acoustic records in bat inventories across Brazil, especially to assess hard-to-capture species.

Moreover, we identified a possible cryptic species using bioacoustics. The identification of cryptic species is a challenge to science, especially at a time when the biodiversity of the planet is threatened (Pfenninger and Schwenk 2007). Inaccurate identifications may hamper real estimates of species richness and diversity in any given habitat and consequently affect our understanding on how much of this biodiversity is threatened. A study detailing the taxonomic composition of 408 new mammal species described since 1993, found that about 60% of these species were cryptic, and bats accounted for 23% of these (Ceballos and Ehrlich 2009). For bats, the number of new species is greater than expected, and the potential for new species is great and the list of known species far from complete (Reeder et al. 2007; Ceballos and Ehrlich 2009; Clare et al. 2011). Most of these new mammalian species have been described in South America and Asia and about 12% of these occurrences are where the landscape is dominated (> 50%) by agriculture, while 20% were in regions with relatively high human population densities, that imply these species are highly vulnerable to anthropogenic threats (Ceballos and Ehrlich 2009). Different species may have differing conservation demands and correct identification of cryptic species may have direct consequences for conservation planning: some endangered taxa may be in fact a complex of multiple cryptic species, with some of them even more rare or endangered than previously supposed (e.g., Bowen et al. 1993; Ravaoarimanana et al. 2004). This seems to hold true for the unknown *Saccopteryx* we recorded. Most of the Atlantic Forest in Pernambuco is gone, with around 12% of the original forest cover remaining (SOS-MA/ INPE 2013). The Reserva Biológica Saltinho, the site of the recordings is a 562 ha fragment of mixed vegetation completely surrounded by a matrix of sugarcane plantations. If this *Saccopteryx* proves to be a new species, its conservation scenario is already alarming.

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